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A new siphonariid (Mollusca: Pulmonata) from southwestern Australia.

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ABSTRACT

A new species of *Siphonaria* from southern and south-western Australia is described. In addition to the shell and radula, the reproductive system, spermatophore and animal's external morphology are described.

INTRODUCTION

Ecological studies of rocky intertidal gastropods of southern Western Australia by Drs R. Black and M. Johnson (University of Western Australia) uncovered an apparently undescribed species of Siphonariidae. Subsequent examination of preserved specimens collected from Rottnest Is, Western Australia, and additional specimens in collections of the Australian Museum and the Museum of Victoria, previously regarded as juveniles of *Siphonaria tasmanica* T. Woods, 1876, *S. denticulata* Quoy and Gaimard, 1833 or *S. diemenensis* Quoy and Gaimard, 1833, confirmed this to be a new species of *Siphonaria*.

TAXONOMY

Family — Siphonariidae Gray, 1840
Genus — *Siphonaria* Sowerby, 1824

Type species — *Siphonaria sipho* Sowerby, January, 1824 (S.D. Gray, April, 1824).

Taxonomic note: Because of invalid original and subsequent type designations, missing type specimens and differing interpretations of the type, a neotype is being erected for *S. sipho* elsewhere under Art. 75 International Code of Zoological Nomenclature.

Diagnosis of genus

Shell patelliform, posteriorly broad, apex subcentral and offset to left posterior or nearly central; external sculpture of straight to wavy radial ribs spaced by rib interstices, siphonal ribs usually distinct on right anterior of shell; interior muscle impression "c" shaped with an aperture on the right anterior side of the siphon which is marked internally by a siphonal groove; jaw present; radula broad with central tooth and numerous laterals; reproductive system with epiphallus and hermaphrodite ducts and glands, a bursa copulatrix and a single genital pore; accessory atrium and/or flagellum may be present.

Subgenus *Siphonaria* Dall, 1870.

Diagnosis of subgenus

Flagellum present; epiphallus duct elongated, thin and muscular but with little connective tissue; spermatophore "thread" like with long thin cylindrical body section; bursal duct long and thin and opening into the genital atrium close to the spermoviduct; accessory atrium absent; shell form and radula dentition variable.

Siphonaria (Siphonaria) jeanae sp. nov.

(pls la-j, 2a-i; figs 1,2)

Shell (pl. 1a-j) (pl. 2a-f) (for definitions of terminology see Jenkins, 1983).

The shell is small, thin, ovate and slightly broader posteriorly. The apex is offset to the left posterior side. The apical sides are convex. Shell height is generally less than half the shell width (table 1). The siphonal groove is indicated externally by two broad juxaposed radial ribs on the right side of the shell. These siphonal ribs don't project beyond the shell lip. Growth striae may be regular and indistinct (pl. 1, a,d,g) or more commonly irregular and coarse (pl. 2, a,c,e). This variation in growth striae, apparent only in specimens from Ceduna S.A., may be due to differences in habitat exposure, for compared to most locations where *S. jeanae* occurs, Ceduna is sheltered. The radial ribbing is flat and unraised with irregular, pale blue-grey ribs and narrower brown interstices, both of which narrow and curve adapically. The number of ribs is variable ($\bar{x}$ = 27, sd = 6.3, n = 35) as is rib width (pl. 1, a-i). The shell interior is smooth and glossy with a white to pale blue spatula. Between the thin, purplish grey adductor muscle scar and the spatula, the interior is purplish brown. The siphonal groove is shallow and straight. The brown to grey outer lip is thickened and unsculptured with white radial bands corresponding with exterior radial ribs.

A light brown periostracum covers the shell exterior, although this may be missing from many specimens due to the exterior being eroded or overgrown with algae. Most specimens from south-western Australia have eroded exteriors, irregular growth striae and thickened shell lips (pl 2, a,c,e).

Shell dimensions

	length mm	width mm	height mm
Holotype	11.9	9.3	4.2
Paratypes (13)	$\bar{x}$= 10.6	8.1	3.7
	sd= 1.2	1.1	0.6
large specimen M.V. coll Albany, W.A.	14.5	11.6	4.6
small specimen A.M. coll Rottnest Is, W.A.	5.2	4.2	1.5

Radula (pl. 2g,h,i)

The radula has a typically siphonariid morphology; a central tooth with an individually variable number of mid and outer lateral teeth arranged in longitudinal rows.

The mean dentition formula is 25.1.25 (n = 3, sd = 2.6) with about 95 transverse rows (sd = 5.3). These rows are parallel and weakly curved (anteriorly convex). One central tooth is present and of the 25 half row laterals, 10.5 (sd = 1.2) are mid and 14.5 (sd = 2.1) outer lateral teeth means respectively. All teeth are weakly concave posteriorly. The central tooth is narrow with a short, pointed mesocone (pl. 2g,h) with a lower profile than the flanking laterals. Inner laterals, characterized by having no side denticles, are absent. The central tooth's base is narrow in the mid section with an anterior cleft and a posterior notched point providing interlocking articulation with adjacent central teeth. The bases of the mid lateral teeth interlock posteriorly and anteriorly. The mesocones of the inner 5-7 mid laterals frequently wear a hole in the back of the tooth in front (pl. 2i). Outer laterals do not interlock between transverse rows. The space between rows increases to the ribbon edges coupled with a gradual decrease in tooth size. The mid lateral teeth are broad based and elongated without flanking ectocones (outer side denticles). The outer lateral teeth have both ecto and endocones and a squared flat mesocone. The mid lateral's mesocone can be either pointed or bicuspidate. Of the radulae examined 2-4 of the inner ($\bar{x}$ = 2.66, sd = 1.2) and invariably 2 of the outer mid laterals were bicuspidate, while the central 3-7 mid laterals ($\bar{x}$ = 5.66, sd = 2.3) were pointed (pl. 2h,i).

Reproductive system (figs 1a,b,c) (material preserved in formalin)

The large yellow, granular ovotestis (ot) is situated in the posterior region of the coelom. Joined to the anterior region of the ovotestis by a short pink lobed hermaphrodite duct (hd), is the thin white spermoviduct (sd). This duct passes under the digestive gland and between the translucent white semicircular folds of the anterior (am) and posterior (pg) mucous glands and the white albumen gland (ag). The small ovate pink seminal vesicle (sv) is connected by a short thin duct to the junction of the hermaphrodite and spermoviducts. The anterior mucous gland decreases in size along the spermoviduct to end just before the duct passes around the adductor muscle and enters the small genital atrium (ga). Dorsal to the junction of the spermoviduct with the genital atrium, the long thin white bursal (or spermathecal) duct (bd) enters the genital atrium. The small brown bursa copulatrix (bc) is spherical when holding spermatophore but deflated when empty. The cream epiphallus gland (eg), situated to the right posterior of the buccal mass, is soft and lobed with a short white flagellum (f) branching from the junction of the epiphallus gland and duct. The epiphallus duct (ed) is long, thick, white and may be centrally looped (fig. 1b). This duct enters the genital atrium almost opposite the bursal and spermoviducts juxtaposed points of entry. The small genital pore (gp) opens from the genital atrium under the mantle and posterior to the right cephalic fold.

Spermatophore (figs 1d, e)

The translucent filamentous tail is 1½ to twice the length of the body section. The cylindrical body test is thin, white and opaque with a rounded head and a short tapering section merging with the tail. Within the bursa up to 4 tightly coiled spermatophores may be found. For an animal 9 mm in length the spermatophores are approximately 5 mm long.

External morphology (material preserved in formalin)

The white to pink sole and wall of the foot are translucent to opaque. The animal's head is inconspicuous being covered by two large rounded white cephalic folds centrally touching over the mouth region. Centralized in each fold is a small black subepithelial "eye" spot. The mantle is grey to white, opaque to translucent (generally folded in preserved specimens) and fringed by a band of small white subepithelial pigment cells. Dense clusters of these are aligned with the white internal shell rib rays. Above the cephalic folds under the mantle, the head region is pustulose and stippled with black to brown pigment cells. Mucous cells cover the foot sole and wall with increasing size and densities around the pneumosomal lobe, over the head, on the cephalic folds and along the mantle edge. The genital pore is indistinct, opening on the siphonal side between the pneumosome and the cephalic fold under the mantle.

Remarks

Although this species is considered correctly placed in the subgenus *Siphonaria,* a forthcoming generic revision will redefine divisive criteria and reassess the generic divisions proposed by Iredale (1940), Hubendick (1946) and McAlpine (1952).

Type material: (p — preserved, d — dry)

Holotype: near boat wharf, Ceduna, S.A. AM* C.123712. coll. B.B. Collette and J.R. Paxton 4 Feb, 1970. BBC-1433.

Paratypes: near boat wharf, Ceduna, S.A. AM C.123713 (3p, 4d), SAM* D.16383 (6p). coll. B.B. Collette and J.R. Paxton, 4 Feb, 1970. BBC-1433; Neptune Bay, S.A. MV* F.15260 (5p); Radar Reef, Rottnest Is, W.A. WAM* 1798-83 (5d). coll. R. Black, 4 Aug, 1979.

Additional material examined:

(unless otherwise noted material examined is in AM collection)

W.A.; Esperance; MV F.20912 (10p), Dampster Hd (4d), North Beach (15+p); Hopetoun, reef on E. side of jetty (1p); Albany; "The Gap" WAM 2018/19-83 (4p), Frenchman's Bay, King George Sound WAM 2015-83 (15+p), Oyster Harbour WAM 2017-83 (1p); Cheyne Beach, near Albany MV F.20941 (15+p), WAM 2013-83 (15+p); S. coast, near Albany (1d); Denmark (1d); Ellensbrook (1d); S. of Cowaramup (2d); Cowaramup Bay WAM 2016-83 (1p); Canal Rocks, near Yallingup (1p); Bunker Bay, Cape Naturaliste (2p); Peel Inlet, entrance WAM 2014-83 (1p); Rottnest Is; (1d), Salmon Pt MV F. 13120 (1d), Radar Reef (15+p, 2d), WAM 633-79 (15+p), Strickland Bay, (15+p), WAM 631-79 (15+p), W. end of Thomson Bay (8p); Yanchep (15+p); total (174+p, 13d).

*Abbreviations:

AM	— Australian Museum, Sydney.
MV	— Museum of Victoria, Melbourne.
SAM	— South Australian Museum, Adelaide.
WAM	— Western Australian Museum, Perth.

Known distribution

Predominantly on steep to vertical rocky intertidal shores. Presently recorded from Kalbarri, W.A. (27°42'S, 114°12'E) (pers. comm. — R. Black) around south-western Australia to Ceduna, S.A. (32°08'S, 133°40'E), and Port Robe, S.A. (37°10'S, 139°45'E) (pers. comm. R. Black). Extensive searching along Victorian and southern N.S.W. shores has failed to establish the existence of *S. jeanae* east of Port Robe.

Electrophoretic analysis of enzyme polymorphism in specimens from Port Robe and Point Sinclair S.A., and Esperance, Rottnest Is. and Kalbarri W.A. (by R. Black and M. Johnson, University of W.A.) provides supporting evidence that these animals are the same species (R. Black — pers. comm.).

Etymology

This species is named after my wife and best friend, Vicki Jean.

DISCUSSION

Three distinct congenors overlap in distribution with *S. jeanae; S. zelandica* Quoy and Gaimard, 1833 has a southern distribution that extends from the eastern to western coasts of Australia, (Jenkins, 1983: fig. 2), *S. diemenensis* overlaps around Port Robe from a southeastern distribution and *S. kurracheensis* Reeve, 1856 overlaps on the southwestern Western Australian coast from a northern distribution.

The shells of these three species show no resemblance to *S. jeanae* (table 1). *S. zelandica* is large and apically low having a pale interior with a white to yellow spatula and broad slightly raised radial ribs spaced by light brown rib interstices (Jenkins, 1983: pls 1-2). The pale shell of *S. kurracheensis* is large and apically tall with strongly convex apical sides, prominent siphonal ribs, thickened and raised radial ribs and a brown to white spatula. *S. diemenensis* is also large and apically tall with thick, white raised ribs spaced by dark brown rib interstices. The shell interior of this species is brown with a darker brown spatula.

The reproductive systems of *S. kurracheensis* and *S. diemenensis* resemble that of *S. jeanae.* All possess long thin epiphallus and bursal ducts, a small epiphallus gland and flagellum with the ovotestis, hermaphrodite duct and seminal vesicle all proportionally similar. However, *S. diemenensis* differs in having no accessory atrium with thinner and longer epiphallus and bursal ducts (Hubendick 1946; 38; McAlpine, 1952: 40, fig. 2). By possessing a large muscular accessory atrium, a "thread" like spermatophore and a large albumen/mucous gland complex, *S. kurracheensis* is subgenerically separated from *S. jeanae. S. zelandica* differs in having a small accessory atrium, a short "spur" like flagellum, a short thickened epiphallus duct, a large epiphallus gland and genital atrium, and a bulbous spermatophore (Jenkins, 1983: figs 3a, b, c: = *bifurcata* in McAlpine 1952: 40 fig. 3).

Although *S. tasmanica* and *S. denticulata* are distributionally separated from *S. jeanae* (distributions in southern Victoria to Tasmania, and around northern Australia from Lakes Entrance, Victoria to Broome, Western Australia, respectively). *S. jeanae* was previously considered a juvenile of these due to similarities in shell ribbing and colouration.

The reproductive system of *S. tasmanica,* a member of the subgenus *Liriola* Dall, 1870, differs in having no flagellum, a large muscular accessory atrium, epiphallus duct and gland, a short thick bursal duct and a large bursa copulatrix (Jenkins, 1981; fig. 3c; Hubendick, 1946: 28). The shell of *S. tasmanica* is larger and taller than *S. jeanae* (table 1) and is distinguished by prominent axial bands of blue, broad and flat radial ribs and a dark brown spatula (Hubendick 1946; pl. 1, figs 12, 13, 14).

The reproductive system of *S. (Siphonaria) denticulata* differs markedly from *S. jeanae* in having a large muscular accessory and genital atrium, long, thin bursal, hermaphrodite and epiphallus ducts. The flagellum is longer and the epiphallus gland is much smaller than those of *S. jeanae.*

The large shell of *S. denticulata* doesn't resemble the shell of *S. jeanae,* but is similar to that of *S. diemenensis,* having prominent raised white ribs spaced by dark brown rib interstices with a dark brown interior but with a white to yellow spatula (eroneously synonymized with *S. diemenensis* in Hubendick, (1946: 38, pl. 2, figs 14, 15, 17).

Another conchologically similar species to *S. jeanae* is the small, Indo West Pacific (Hawaii to Christmas Is, Indian Ocean) siphonariid *S. normalis* Gould, 1864. However, with a northern Australian distribution, south to Dampier in Western Australia, *S. normalis* is distributionally separated from *S. jeanae,* and the shell is distinguished by having raised ribbing, two prominant siphonal ribs, no external bluish colouration and a dark brown shell margin. The reproductive system of *S. normalis* differs in having two flagellam on the epiphallus gland, an accessory organ and a smaller hermaphrodite duct.

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Table 1. Comparative shell dimensions, rib numbers, (mm) and height ratios for cogenors of *S. jeanae* sp. nov.

species	length		width		height		l;h		w:h		ribs		n
	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	
S. jeanae sp. nov.	10.40	1.60	8.00	1.40	3.40	0.70	3.20	0.43	2.44	0.34	27.00	6.3	35
S. zelandica	15.10	3.67	12.20	2.70	4.20	0.90	3.69	0.59	2.92	0.34	17.60 (primary)	2.50	180
S. diemenensis	20.89	3.38	16.90	2.97	7.58	1.99	2.86	0.54	2.31	0.44	26.80	6.5	75
S. kurracheensis	18.78	2.35	15.75	2.13	7.04	0.92	2.68	0.26	2.25	0.31	48.21	4.56	14
S. tasmanica	15.75	4.24	11.39	3.52	7.01	3.58	2.39	0.45	1.81	0.34	46.60	5.12	71
S. denticulata	24.46	2.04	19.74	1.32	7.99	1.07	3.10	0.35	2.46	0.39	42.65	4.53	20

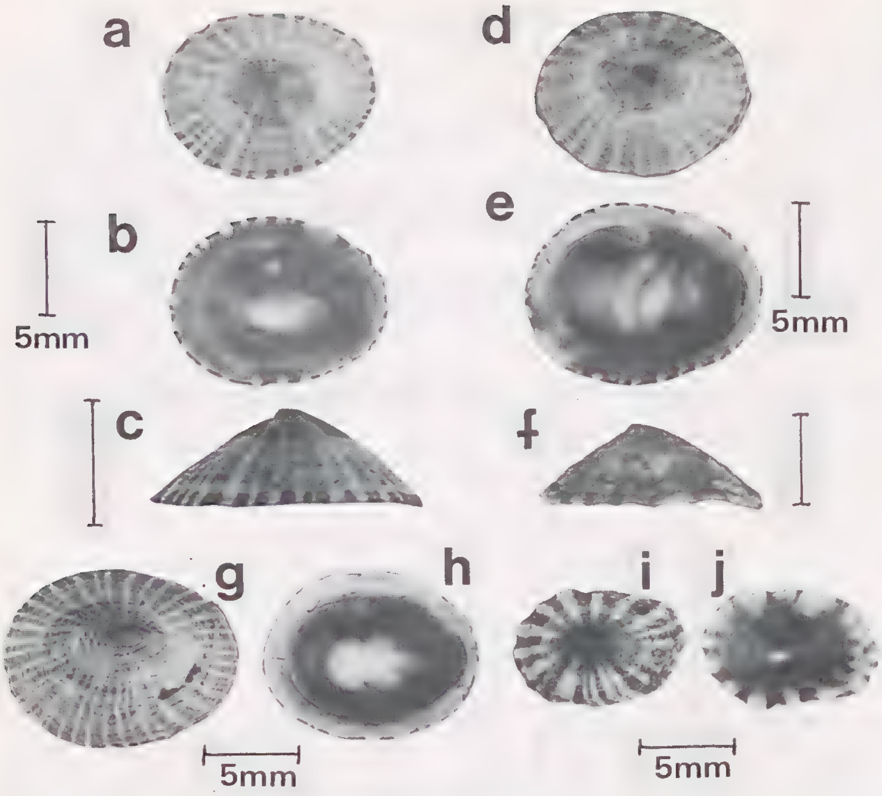

Plate 1. *S. jeanae* sp. nov. a-c). holotype, Ceduna, S.A. (repro. syst. fig. 1a; rad pl. 2g); d,e) paratype Ceduna, S.A.; f) Rottnest Is, W.A.; g, h) paratype, Ceduna, S.A.; i, j) paratype, Radar Reef, Rottnest Is, W.A.

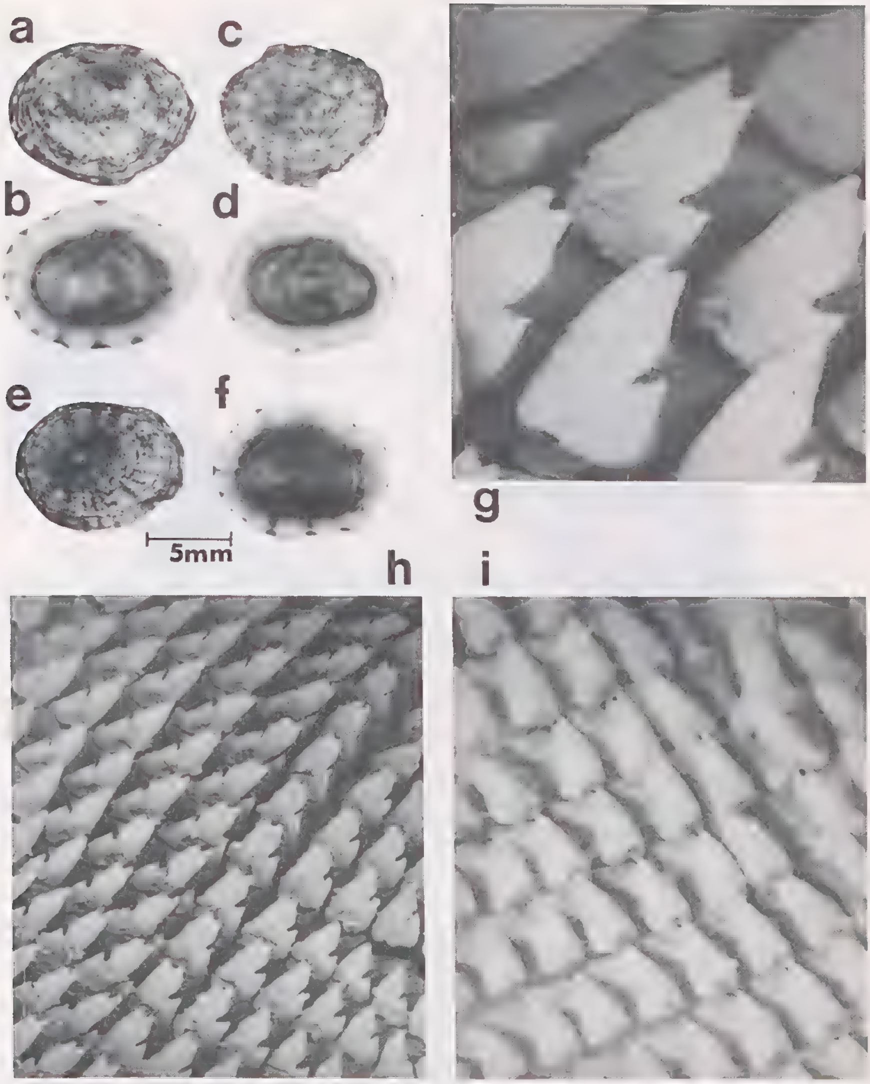

Plate 2. *S. jeanae* sp. nov. a-f) paratypes, Radar Reef, Rottnest Is., W.A.; g-i) radula, central and mid lateral teeth; g) holotype, Ceduna, S.A. X 1400 sem stub 1201 (shell pl. 1a, b, c; repro. syst. fig. 1a); h, i) paratype, Radar Reef, Rottnest Is., W.A. h) X 480; i) X 710; SEM stub 1202.

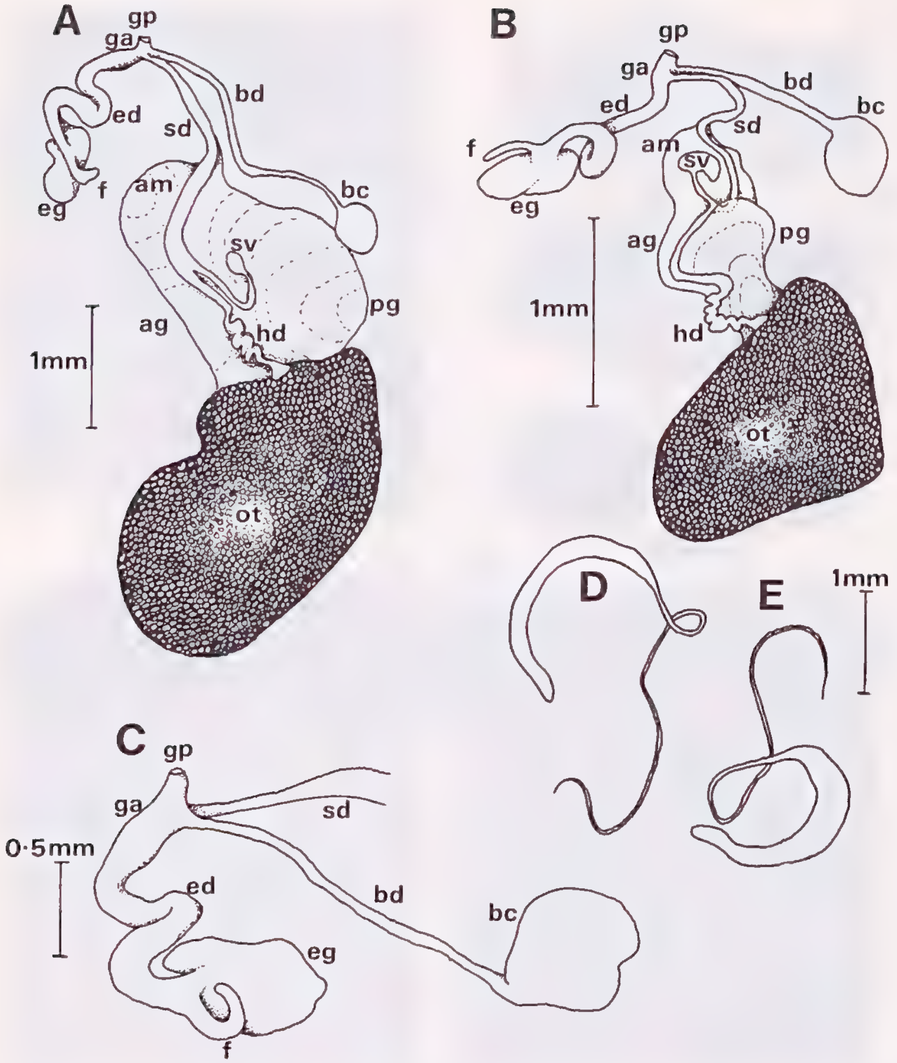

Figure 1. The reproductive system and spermatophore of *S. jeanae* sp. nov. a) holotype, Ceduna, S.A. (shell pl. 1a, b, c; rad. pl. 2g); b) paratype, Ceduna, S.A.; c) paratype, Radar Reef, Rottnest Is., W.A.; d-e) spermatophore, paratype, Radar Reef, Rottnest Is., W.A.

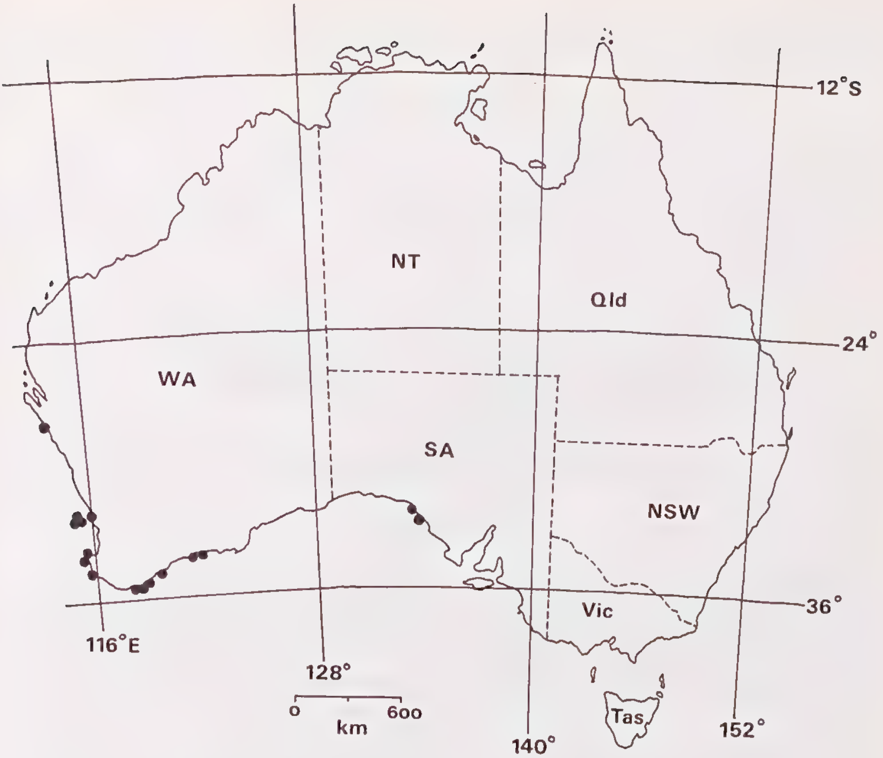

Figure 2. Distribution of *S. jeanae* sp. nov.

Abbreviations

ao — accessory atrium, ag — albumen gland, am — anterior mucous gland, bc — bursa copulatrix, bd — bursal duct, ed — epiphallus duct, eg — epiphallus gland, f — flagellum, ga — genital atrium, gp — genital pore, hd — hermaphrodite duct, ot — ovotestis, pg — posterior mucous gland, sd — spermoviduct, sv — seminal vesicle.